The Field of Telerobotics

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Telerobotics is perhaps one of the oldest fields in robotics. Since its humble beginning in the 1940s when the first teleoperator was designed, the focus had been primarily on the nuclear, space, and underwater applications until the 1980s. The recent advances in computing power and in communications have led to the emergence of new applications such as telesurgery, semiautonomous telerobotics, live power line maintenance, and others. On the other hand, progress in bilateral control has been the key point for the development of new master–slave architectures, which are important in precise telemanipulation tasks. This pervasive interest has spawned the continuous development of the new telerobotic systems.

This special issue is a modest attempt to capture the current application and technology trends in telerobotics. Five articles encompassing telerobotic applications, human–robot control mode, and usage of stereoscopic interfaces have been included in this special issue. Articles by Martin et al. and Hagn et al. address space exploration and telesurgery applications in telerobotics. Murphy and Burke provide different control architectures for remote control of robots, which are used in applications such as search and rescue in hostile environments. Ferre et al. and Livatino et al. explain the usage of stereoscopic interfaces in telerobotics. Hereby, one of these articles describes the main constraints of such devices and gives illustrative examples, whereas the other provides a comparison between the monoscopic and stereoscopic interfaces when guiding mobile robots.

The article by Martin et al., from the Canadian Space Agency (CSA), is focused on space telerobotics. This article describes the Avatar project, which consists of a series of missions used to validate the autonomous robotics and ground operations (ARGO) software package being developed by the CSA. The proposed software framework subsumes various task-dependent autonomy paradigms ranging from supervisory control to autonomous operations. The ultimate goal is to investigate different commands and control schemes allowing operators to interact with robots in space or on other planets. This article presents an overview of the first planned mission, Avatar RESCUE, where a robotic test bed located at the CSA headquarters will be operated from the International Space Station using a low-bandwidth communication link.

Hagn et al., from the German Aerospace Center (DLR) in Germany, present the design of a new robot for telesurgery. Surgical applications are currently among the most active areas of telerobotics. This article describes a medical robot system developed at the DLR for minimal invasive laparoscopic and open surgery. The requirements for an ideal telemanipulator are formulated, and the developed systems are explained in detail. In addition, design of surgical instruments attached to the robot, to enhance manipulability and reestablish full dexterity inside the patient's body, is also discussed.

Murphy and Burke explore the paradigm of human–robot interaction in their article. This is traditionally a key point in telerobotics because the new strategies for human interaction allow an optimized execution of remote tasks. The article describes and analyzes three models of teleoperation for remote presence applications, such as emergency response, law enforcement, and military operations in urban terrain, where the human operator employs a robot to obtain real-time perception at a distance. Using a joint cognitive systems (JCS) framework, the authors contend that the semiautonomous shared roles model, which lies between the supervisory and the autonomous framework, can effectively model a wide variety of emerging applications.

The article by Ferre et al. is focused on the application of stereoscopic interfaces for telerobotics. It starts with a brief introduction on human capabilities to understand the main requirements and limitations, followed by some guidelines in capturing stereoscopic images by using binocular cameras and a discussion on the camera's layout. Finally, the most common interfaces are described, which include examples of possible applications in telerobotics.

Article by Livatino et al. presents experiments for guiding a mobile robot by using different stereoscopic interfaces. The authors compare guidance performance by using monoscopic and stereoscopic images. Two different kinds of stereoscopic interfaces have been used; the first is based on polarized images projected to a wall, and the second uses colored stereoscopic images that are displayed on a laptop screen. The results demonstrate a better performance of stereoscopic images and reveal some features of these specific interfaces.

The objective of this special issue is to present emerging applications and perspectives in telerobotics. Admittedly, there are several emerging vistas that have not been covered in this issue; nevertheless, we hope that the reader will be able to share our excitement about the new developments in the field. Finally, we thank the authors for their valuable contributions in this endeavor.

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